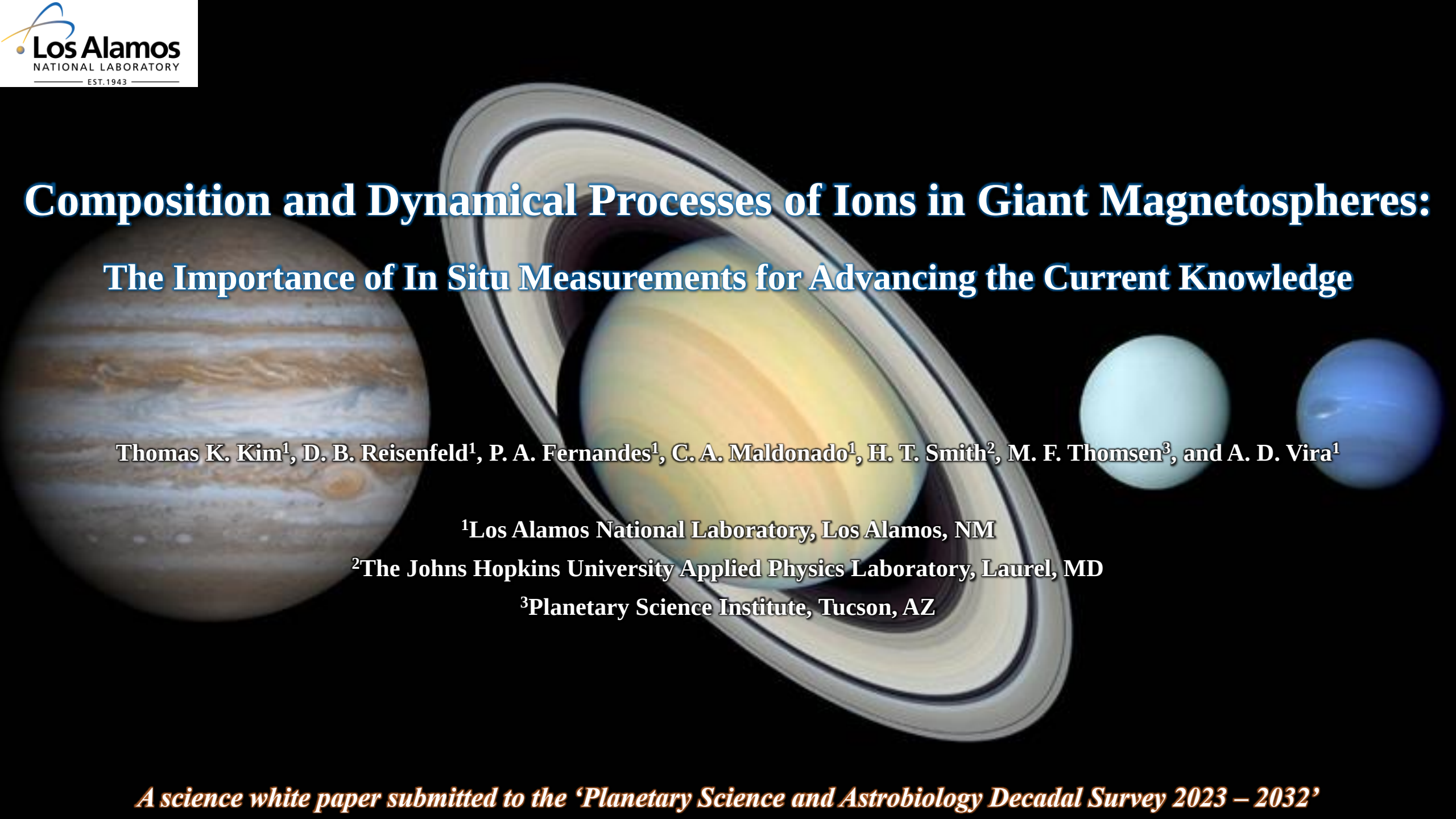
LA-UR-20-28874
Approved for public release; distribution is unlimited.

Title: Composition and Dynamical Processes of Ions in Giant Magnetospheres: The Importance of In Situ Measurements for Advancing the Current Knowledge

Author(s): Kim, Kyoung Ho

Intended for: Report

Issued: 2020-11-01



Composition and Dynamical Processes of Ions in Giant Magnetospheres:

The Importance of In Situ Measurements for Advancing the Current Knowledge

Thomas K. Kim[1], D. B. Reisenfeld[1], P. A. Fernandes[1], C. A. Maldonado[1], H. T. Smith[2], M. F. Thomsen[3], and A. D. Vira[1]

[1]Los Alamos National Laboratory, Los Alamos, NM

[2]The Johns Hopkins University Applied Physics Laboratory, Laurel, MD

[3]Planetary Science Institute, Tucson, AZ

A science white paper submitted to the 'Planetary Science and Astrobiology Decadal Survey 2023 – 2032'

- **Magnetospheric ion composition in outer planets are often very complex due to a significant amount of plasmas arise from the internal source → Typically comprised of multiple ions with various atomic/molecular species and charge states.**

- **Measuring only the energy-per-charge of an ion (e.g., faraday cups) does not provide ion composition.**
  - **Complex charge states and various ion species are not directly resolved with energy-per-charge measurements.**
  - **Many physical assumptions and support of remote observations must be made to do this.**

- **For example, there has been multiple spacecraft sent to the Saturn's magnetosphere, but it was Cassini spacecraft discovered that the magnetosphere is filled with water group ions by the measurement of the energy-per-charge and mass-per-charge of an ion provided by the Cassini Plasma Spectrometer (CAPS).**

- **In this white paper, we emphasize the importance of in situ ion composition measurements provided by plasma mass spectrometers in planetary magnetospheres (Uranus and Neptune) aimed for future planetary missions.**

- **We present our current understanding on magnetospheres of Uranus and Neptune that are largely based on Plasma Science Investigation (PLS, faraday cups) and Low Energy Charged Particle (LECP) instrument on Voyager 2 and what measurements need to be made to improve it.**

- **We emphasize that the future missions equipped with plasma mass spectrometers must visit these magnetospheres again to advance our current knowledge.**

- **Finally, this white paper summarizes key science questions that needs to be addressed which all of them requires a direct ion composition measurements from a plasma spectrometer.**